Space Weather Technical Forecast

Issued on Saturday, 27 July 2024 at 01:10 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/Minor Storms Days 1 and 2 (26-27 Jul). Chance of R1 Radio Blackouts throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with an M1.7 flare observed at 26/0442 UTC from AR3761 near the west limb. There are currently twelve sunspot regions on the solar disc. AR3762 remains the largest and most complex region. It has now moved into the southwest quadrant and continues to show plenty of spots, including a couple of delta spots, along with some magnetic looping. AR3761 is now approaching the southwest limb and has become increasingly difficult to view and analyse. A cluster of sunspot regions is also transiting across the southeast quadrant, which have been growing in size and complexity as they transit across the disc. A new region, still unnumbered, has recently emerged over the northeast limb. All other remaining regions appear small, simple and/or largely unchanged.

A dimming event near centre disc does not appear to have produced a CME, therefore no new Earth directed CMEs have been seen in coronagraph imagery in the last 24 hours. **Solar Wind / Geomagnetic Activity:** Solar winds, as measured by ACE at L1, showed CME effects which appeared to transition to a coronal hole fast wind, although with an uncertain source. Wind speeds became elevated for much of the period, briefly peaking at 600 km/s, before declining to near 470 km/s. Density was well below average. The Interplanetary magnetic field, Bt, was initially strong, near 17nT, but is now weak around 6nT. The north-south component, Bz, was initially moderate variable, down to -13nT, but became weakly variable during the period. The phi angle was predominately positive (away from the Sun) but became negative (towards the sun) between 26/0400-0945 UTC. Geomagnetic activity was Unsettled to Active (Kp 3-4), with a G1/Minor Storm (Kp5) interval observed 26/0300-0600 UTC.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 is at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was at background levels. The 24-hour fluence was well below Active, with 9.63e5 integrated pfu observed at 27/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with a chance of further M-class flares.

Solar Wind /Geomagnetic Activity: A flare near AR3764 at 23/1430 UTC gave a CME, perhaps giving Earth a glancing blow early on Day 1 (27 Jul). In addition, a dimming north of AR3762 around 25/0100 UTC may have given a CME with a risk of some Earth directed influence, however it cannot be analysed due to far side CME contamination and the speed can only be guessed at. Confidence is low in both these features, giving significant uncertainty in the forecast through this period. Earth may also be under the influence of a fast wind from an unidentified coronal hole. Wind speeds are thought likely to gradually decline in the absence of CME influence over the next couple of days.

Geomagnetic activity is expected to be Quiet to Active with a chance of G1/Minor storm intervals on Day 1 if we see any CME influence, then a slight chance of G1 intervals through the following days with low confidence of a potential further CME arrival as discussed above.

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at

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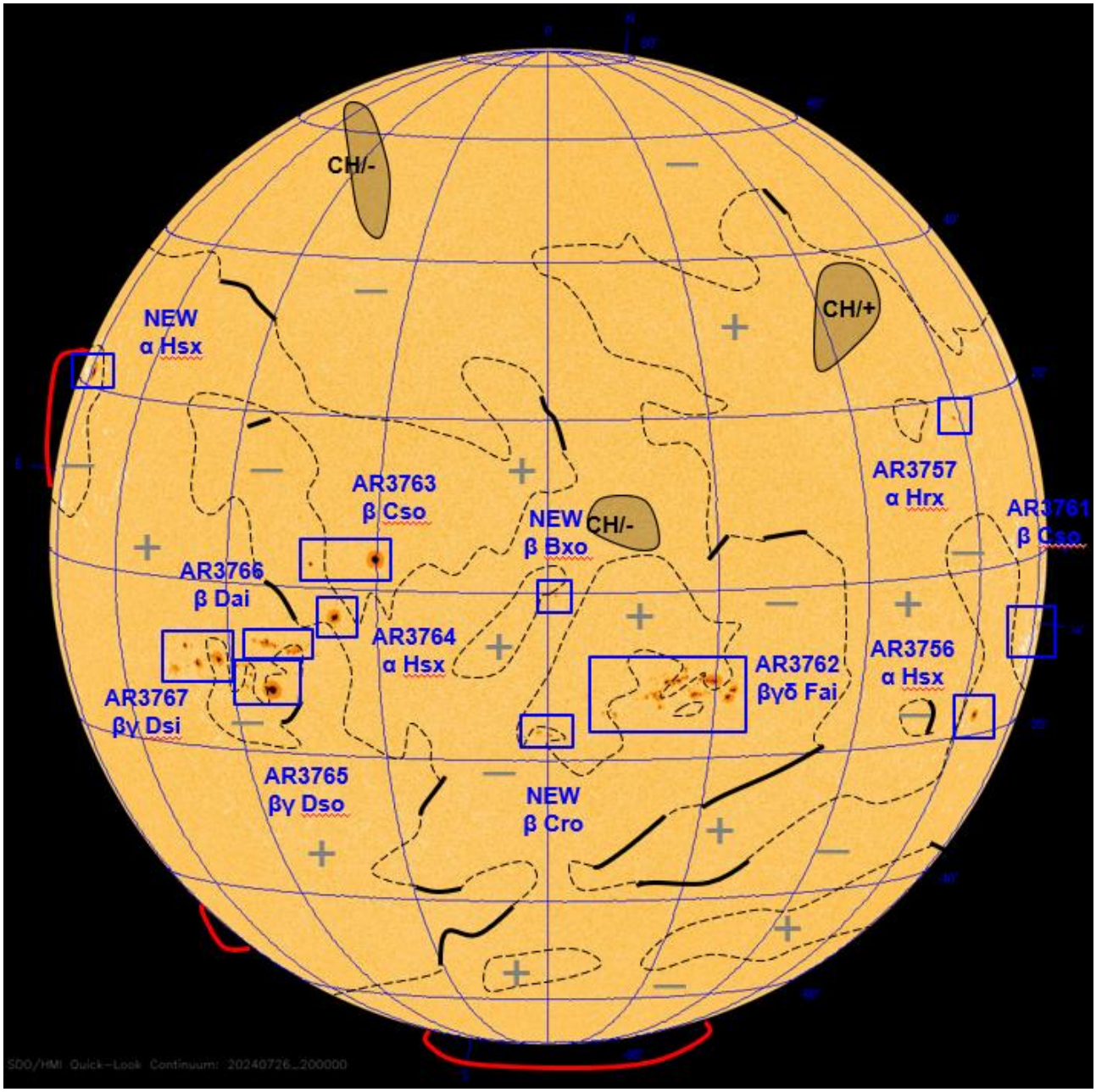
background levels. However, there is a slight chance of exceeding the S1/Minor Storm threshold should any notable flares occur, most likely from AR3762.
The high energy electron flux may show an increasing trend in the next few days after the recent CME influence. The associated 24-hour fluence is most likely to remain below the Active threshold (1e8 integrated pfu) but with a potential rising trend during the period.

Figure 1. Solar Analysis Valid 26/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A long period M2.4 flare close to the southeast limb near AR3764 at 23/1430 UTC gave a wide and moderately fast CME, perhaps giving Earth a glancing blow early on Day 1 (27 Jul). Confidence in this feature arriving is low, however, due to limited coronagraph imagery at the time. In addition, a dimming and opening in the magnetic field lines north of AR3762 around 25/0100 UTC may have given a CME with a risk of some Earth directed influence. Unfortunately, any CME was obscured in coronagraph imagery by a large far sided halo CME. Should a CME have been produced, it cannot be analysed and the speed can only be guessed at. Overall, there is significant uncertainty in the forecast through this period.

Earth may also be under the influence of a fast wind from an unidentified coronal hole, with solar wind speeds elevated but a stable and weak magnetic field. Wind speeds are thought likely to gradually decline in the absence of CME influence over the next couple of days. There is a small and tenuous unnumbered coronal hole just west of centre disc which may give slightly elevated wind speeds later in the period, but is unlikely to have significant impact.

Geomagnetic activity is expected to be Quiet to Active with a chance of G1/Minor storm intervals on Day 1 if we see any CME influence, then a slight chance of G1 intervals through the following days with low confidence of a potential further CME arrival as discussed above.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	30	10	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
23/2224	Partial	AR3764	SE	560 km/s	26/1500 UTC +/- 12 hrs	Low confidence

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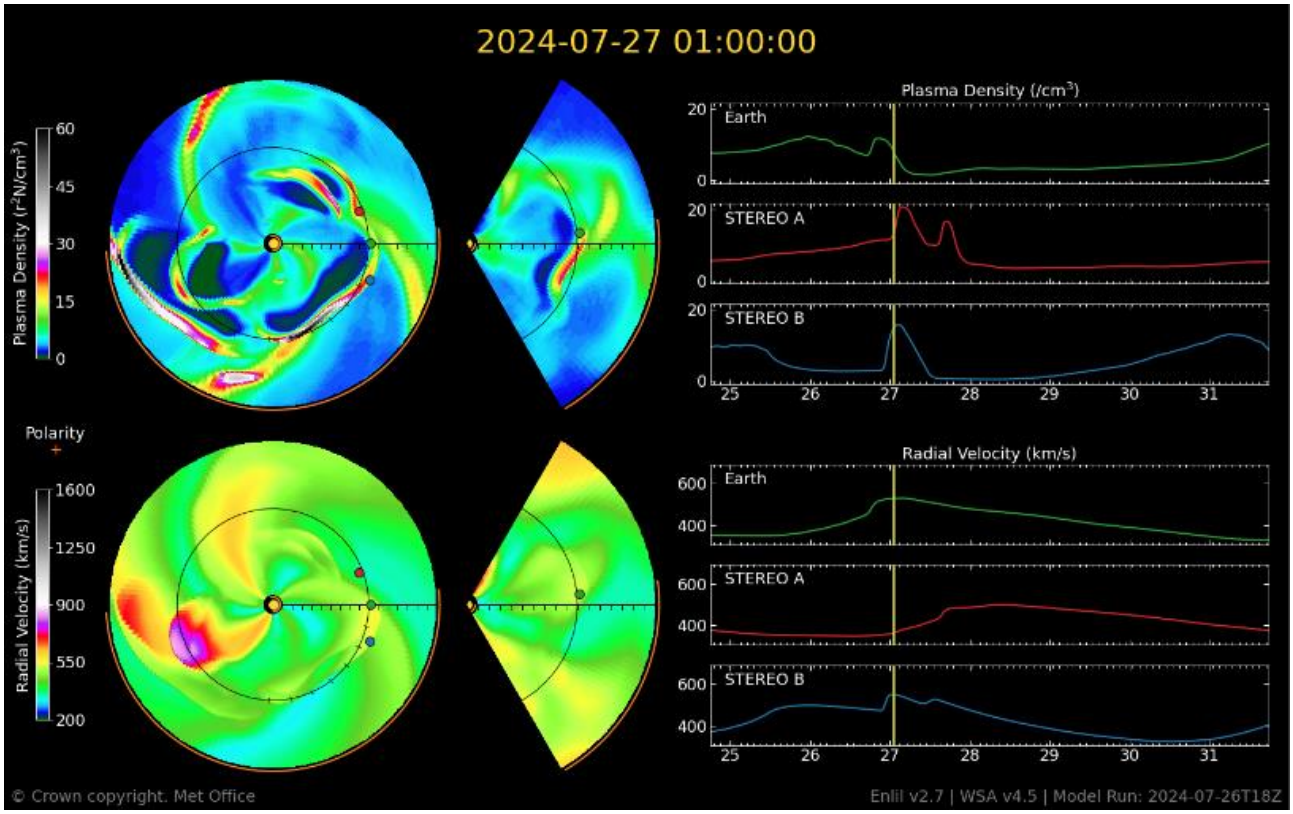
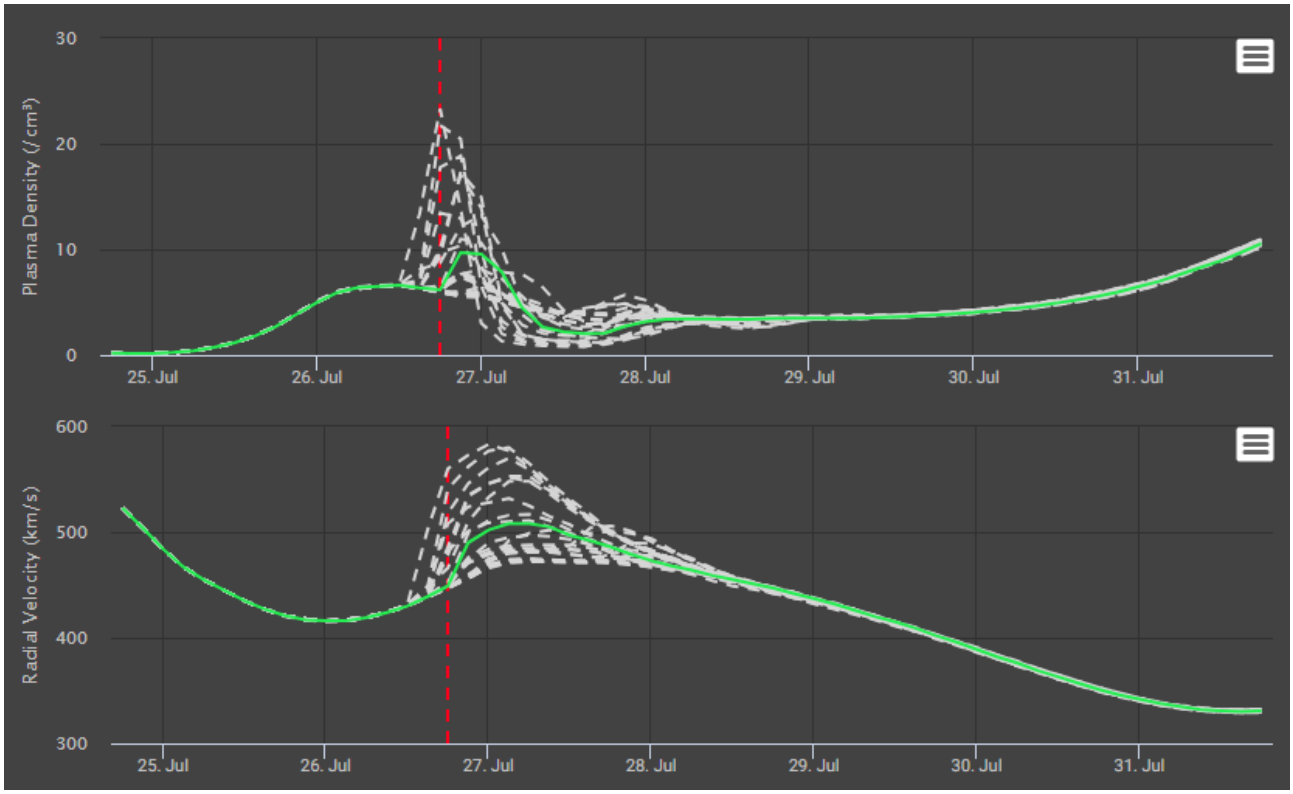
Figure 2:MOSWOC Enlil and ensemble, showing a potential CME glancing blow on Day 1 (27 Jul). Otherwise, Enlil has been underestimating the wind speeds, but a gradual decline seems most likely.





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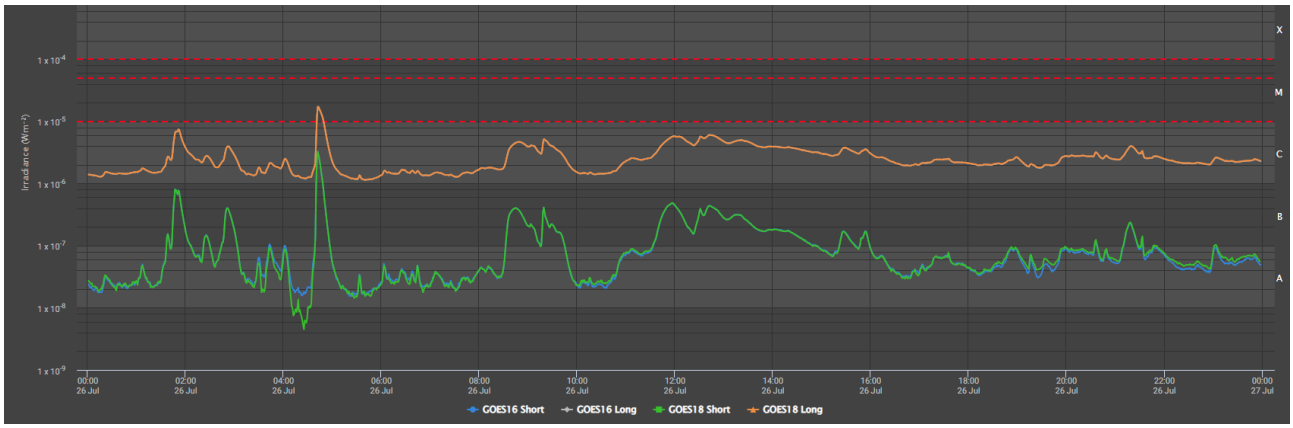
Radio Blackouts - X-Ray Flares:
Solar activity has been Moderate with an M1.7 flare observed at 26/0442 UTC from AR3761 near the west limb.

There are currently twelve sunspot regions on the solar disc. AR3762 remains the largest and most complex region. It has now moved into the southwest quadrant and continues to show plenty of spots, including a couple of delta spots, along with some magnetic looping. AR3761 is now approaching the southwest limb and has become increasingly difficult to view and analyse. A cluster of sunspot regions is also transiting across the southeast quadrant, which have been growing in size and complexity as they transit across the disc. A new region, still unnumbered, has recently emerged in the northeast limb. All other remaining regions appear small, simple and/or largely unchanged.

Activity is expected to be Low to Moderate with a chance of further M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: X-ray flux at GOES16 and 18.



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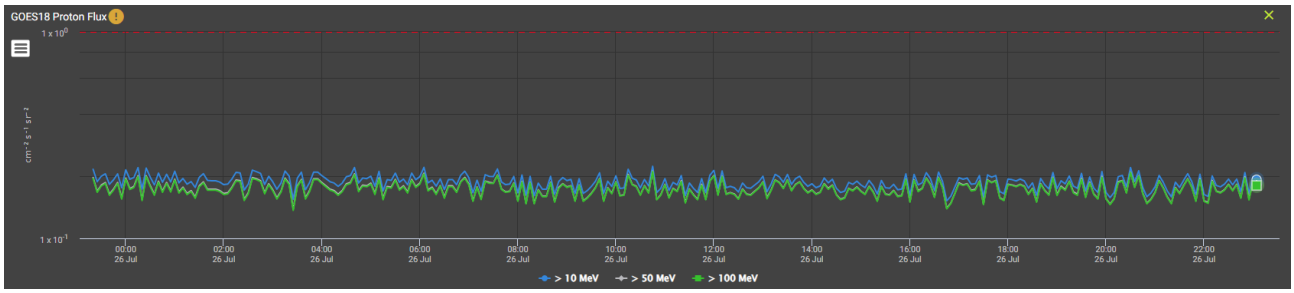
Solar Radiation Storms - (High Energy Protons):
High energy protons are currently at background levels. Proton flux is most likely to remain at background levels, although there is a slight chance of reaching the S1/minor radiation storm threshold if any notable flares occur from the west of the disc. AR3762 is the most likely candidate to be the cause of any potential increase in proton flux.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton flux at GOES18, which is now at background levels.



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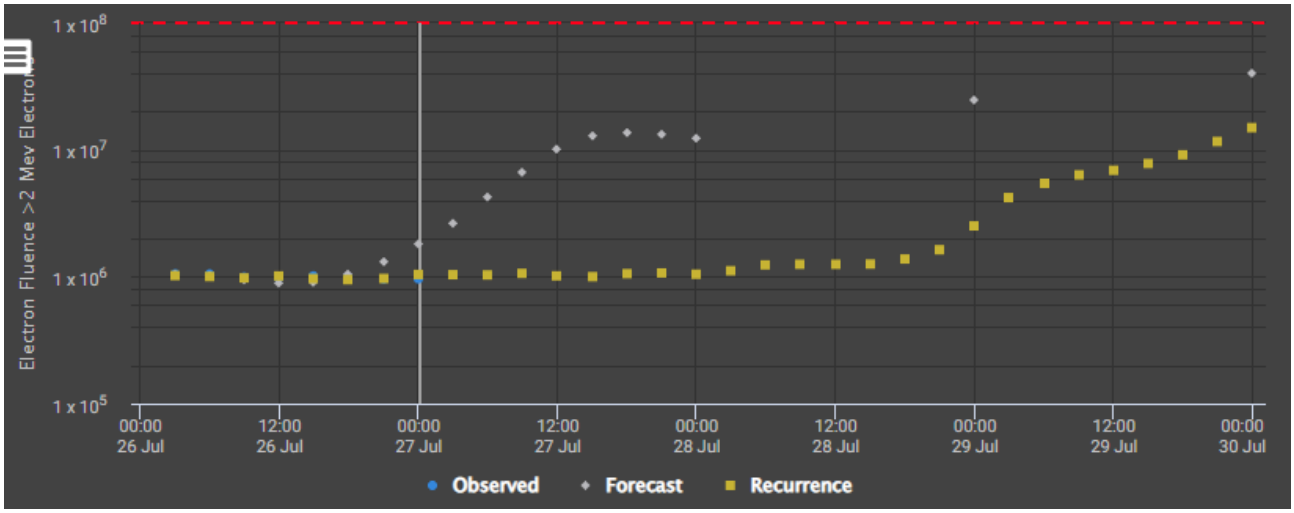
High Energy Electrons Event (≥ 2MeV):
High energy electron flux, as observed by GOES-16, is expected to remain at background levels for the start of the period. The recent CME and potential fast wind enhancement may have caused an increase in electron flux below GEO, but the potential for further CME arrivals could suppress this once again. Overall, electron flux is most likely to stay at background levels, but as the solar wind speeds decline there is the possibility of an increase to peak at moderate or perhaps high levels.

The associated electron fluence is most likely to persist below the Active threshold (1e8 integrated pfu), but with the potential for a rising trend during the period. The latest MOSWOC REFM output is forecasting a rising trend below Active through the next three days, which seems like good guidance in the absence of further CME influence.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM which is forecasting a rising fluence trend below Active (1e8 integrated pfu).



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